VENOUS THROMBOEMBOLISM RISK ASSESSMENT IN RENAL TRANSPLANT PATIENTS AT THE QUEEN'S MEDICAL CENTER IN HAWAI`I

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Dedication

This work is dedicated to my dear family. Thank you for never giving up on me.

Acknowledgments

I would like to express my sincere gratitude to my exceptional committee members: Dr. Ceria-Ulep, thank for stepping in and for your continued support urging me forward, Dr. Constantin thank you for your keen eye, and Jennifer Watarai, thank you for opening your facility to me and your constant encouragement. A special thanks to former committee chair, Dr. Codier. Thank you for helping me during the roughest part of my journey. I hope retirement is treating you well.

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I truly appreciate each and every one of you.

Abstract

Introduction

Venous thromboembolism (VTE) is a common post-operative renal transplant complication. VTEs are not only life-threatening, but also require longer hospital stays and/or hospital readmission. There are no universally accepted VTE screening guidelines for renal transplant recipients (RTRs). The Caprini risk assessment model was the most widely used and validated VTE screening tool in the literature. It was adapted and used in this project's intervention. In collaboration with The Queen's Medical Center Transplant Center (QMCTC), an evidence-based quality improvement project was conducted to address the incidence of VTE. The Iowa Model was used framework to guide the process. The purpose of this evidenced-based practice (EBP) project was to implement and evaluate a program that decreased the incidence of venous thromboembolism (VTE) in adult QMCTC patients following renal transplant surgery.

Methods

The target population was the QMCTC RTRs who underwent surgery. Patients were screened using the QMCTC-adapted Caprini tool prior to surgery. The results from the assessments were then forwarded to the transplant physician team. Methods to assess the program outcomes included monitoring VTE incidence during the implementation period and physician survey.

Results

During the five-month intervention period, 22 potential candidates for renal transplant were screened, while only 12 underwent surgery. Age and history of major surgery were the only identified risk factors. Zero incidence of VTE was recorded and the overall VTE incidence rate decreased by 0.5%.

Discussion

The results suggested screening RTRs prior to surgery may decrease the incidence of VTE. Although correlational, the results from the project supported the continued use of the intervention as a cost-saving measure to enhance patient care. Additional implications included raising awareness on VTE and the benefits of EBP projects.

Table of Contents

Acknowledgments iii

Abstract iv

Introduction iv

Methods iv

Results iv

Discussion v

List of Tables xi

List of Figures xii

CHAPTER 1. EXECUTIVE SUMMARY 1

Introduction 1

Background/problem 1

Conceptual framework 1

Literature review and synthesis 1

Methods 2

Design 2

Practice change description 2

Setting and sample 2

Data collection 3

Description of participants 3

Data analysis findings. 4

Discussion 4

Interpretation of results 4
Implications 5
Limitations 5
CHAPTER 2. PROBLEM 6
Introduction 6
Conceptual Framework 6
Step 1: Identifying Triggers 8
Step 2: Organizational Priority 8
Step 3: Team Formation 9
Step 4: Literature Critique and Synthesis 9
Evaluating the literature evidence 10
Findings from the Literature Review 12
VTE Risk Factors 12
VTE Risk Assessment 15
VTE Prophylaxis 17
Weaknesses, Gaps, Limitations 19
Innovation/Objectives 20
Summary 21
CHAPTER 3. METHODS 22
Introduction 22
PICO statement 22
Clinical question 22

Objective 23
Implementation Plan 23
Overview 23
Practice change 23
Characteristics of the innovation 23
Timeline 25
Sampling plan 25
Stakeholder engagement plan 28
Evaluation Plan 31
Evaluation question 31
Integrity of the evaluation design 31
Program description 32
Definitions 33
Data management plan 35
Resources 36
Dissemination Plan 37
Limitations 39
Summary 40
CHAPTER 4. RESULTS 41
Objective 41
Step 5: Practice Change Pilot 41
Step 6: Practice Change Implementation 41

Step 7: Evaluate Outcomes 42

Description of sample 42

Level 1 Risk Factors 42

Level 2 Risk Factors 42

Level 3 Risk Factors 42

Literature Risk Factors 43

Trend analysis for process and outcome measures. 43

Evolution of Project 45

Expected vs. actual outcomes 45

Facilitators 45

Barriers 46

Summary 46

CHAPTER 5. DISCUSSION 47

Interpretation of Findings 47

VTE incidence 47

Transplant physician survey 48

Implications and Recommendations 49

DNP Essentials 50

Plans for Dissemination 50

Summary 50

References 52

Appendix A 60

Appendix B 61

Appendix C 63

Appendix D 65

Appendix E 66

Appendix F 79

List of Tables

Table 1. Agree II Clinical Practice Guideline Scores 11

Table 2. Recommended Prophylaxis Regimens Based on Caprini Score and Risk Stratification 17

Table 3. Recommended Prophylaxis Regimens Based on Caprini Score and Risk Stratification 18

Table 4. Adopters, Role Designations, and Adopter Categories 28

List of Figures

Figure 1. The Iowa Model for Evidence-Based Practice. 7

Figure 2. Mosby's Level of Evidence. 10

Figure 3. Number of Articles Reviewed and Mosby's Level of Evidence Rating. 11

Figure 4. Proposed Project Timeline. 26

Figure 5. Stakeholder Mapping. 29

Figure 6. Renal Transplant Recipient Self-Reported Ethnicities. 43

CHAPTER 1. EXECUTIVE SUMMARY

Introduction

Background/problem. Thromboembolism is a common post-operative renal transplant complication. Venous thromboembolisms (VTEs) are life-threatening. They require longer hospital stays and/or hospital readmission. Daily costs resulting from VTEs have been estimated at $1,664 per patient (Dasta et al., 2014).

Currently, there are no universally accepted VTE prophylaxis guidelines for renal transplant patients. During an investigation into the causes of the VTEs, a survey of The Queen's Medical Center Transplant Center (QMCTC) surgeons revealed varying VTE prophylaxis treatment plans based on individual surgeon experience and preference. Some favored only early ambulation and intermittent pneumatic compression (IPC), while others opted for pharmacologic interventions.

Studies have indicated this incidence can range from 7.9% to 9.1% (Poli et al., 2006; Verhave et al., 2014). Since 2014, Honolulu, Hawai`i's QMCTC conducted 124 renal transplant surgeries. Seven cases of VTE have been reported within six months after surgery—a 5.6% incidence. This was the trigger for this evidence-based practice (EBP) project. While the incidence rate was below the literature rate, four reported VTEs within a year prompted the need for this project.

Conceptual framework. Implementing change within a large organization required a systems-based approach. Titler et al.'s (2001) Iowa Model utilizes an algorithmic flowchart approach, which tracks project implementation and employs feedback loops.

Literature review and synthesis. The search was split up into several subtopics: VTE risk factors, VTE risk assessment, and VTE prophylaxis. An electronic search was completed

utilizing PubMed, CINAHL, Google Scholar, National Guideline Clearinghouse, and the Cochrane Library.

Eighty-seven articles published between 1997 and 2016 were identified. Forty-four articles were omitted based on relevance to this project. The remaining 43 were examined. Four clinical practice guidelines (CPGs) were also scrutinized.

Following the literature synthesis, the Caprini risk assessment model (RAM) appeared to be most widely used and validated VTE RAM. Studies evaluating the validity of the scores and value for predicting VTE events have received much support (Bilgi et al., 2016; Grant et al., 2016; Lobastov et al., 2016; Obi et al., 2015; Zhou et al., 2014). Mentions of other VTE RAMs were limited and generally cited in comparison with the Caprini RAM.

Methods

Design. This project examined the effect of a VTE risk assessment screening program on the occurrence of VTE in QMCTC adult renal transplant patients. The evaluation design was impact and pre-test/post-test of VTE incidence.

Practice change description. A modified version of the Caprini RAM was selected and adapted to QMCTC's specifications. Redundant or not applicable risk factors were removed. Risk factors identified in the literature were added. The modified VTE risk assessment tool was administered to renal transplant patients prior to surgery. The results from the assessment were then forwarded to the transplant physician team.

Setting and sample. This EBP Doctor of Nursing Practice project was conducted at QMCTC—the only organ transplant center in Hawai`i and the Pacific Rim (Queen's Transplant Center, 2014b). The transplant center provides five transplant program including liver, adult

kidney, pediatric kidney, pancreas, and living kidney transplant programs (Queen's Transplant Center, 2014c).

The target population was the renal transplant patients undergoing the assessment. The sample patient population included all QMCTC RTRs age 18 or older undergoing renal transplant surgery during the implementation period. All patients who fit the inclusion criteria were included in the sample.

Data collection. During the screening process prior to surgery, each renal transplant patient's medical record was reviewed for risk factors as indicated by the risk assessment tool. Any information not available or unclear from the medical record was asked to the patient directly. Each patient was assigned a number and had their own risk assessment file. Identifying information was not recorded. A summary of each patient's VTE risk assessment was forwarded to the transplant physician team as they were processed.

For the incidence of VTE, data was obtained from the medical record or by patient report and verification. In the event of a reported VTE, the number of days post-operation to incidence was recorded. All information was stored on an encrypted database at QMCTC. Access was only available to authorized team members.

Results

Description of participants. Twenty-two patients were potential candidates for renal transplant during the implementation period. Twenty-one of those patients were above the age of 18 and met inclusion criteria and underwent VTE risk assessment screening. Twelve of those patients underwent renal transplant surgery. Eleven of the patients were male (92%). The average age of the patient population was 49 years (range 28 to 68 years), with four patients each

in the under 40 years, 40 to 60 years, and above 60 years age groups. Most of the patients were Asian or part-Asian (92%), while 17% of the patients were Caucasian or part-Caucasian.

Data analysis findings.

Level 1 Risk Factors. The most predominant Level 1 Risk Factors were age 40-59 years (33%) and major surgery (25%).

Level 2 Risk Factors. Age 60 to 74 years was the only Level 2 Risk Factor (33%).

Level 3 Risk Factors. There were no Level 3 Risk Factors identified in the sample population.

Literature risk factors. For literature risk factors, low hematocrit (less than 40% for males and less than 36% for females) was identified in 92% of the patient sample (range 28.8% to 39%).

During the five VTE checks at the end of August, September, October, November, and December 2017, zero incidence of VTE was noted in the RTR records. The VTE incidence rate in the RTR patient sample was 0%. The overall incidence rate since 2014 decreased from 5.6% to 5.1%.

Discussion

Interpretation of results. Representing one of the primary outcome measures for this project, VTE incidence was closely monitored throughout the implementation period. The calculated VTE incidence rate for this project was a 0.5% decrease, which was less than the outcome goal set at 1%. The total number of renal transplants was far less than the estimated figures, contributing to a smaller decrease in incidence rate. The correlational value of the decrease in incidence rate must be interpreted cautiously. Without a full retrospective chart review examining the variables contributing to the decrease, a definitive causal connection

between the effect of this project and the incidence rate cannot be assumed. Yet, a 0.5% decrease in the overall VTE incidence rate saved QMC roughly $5,770, and for every VTE readmission averted, approximately $8,486 (Dasta et al., 2014).

Implications. One key implication following the implementation of this project was raising awareness. Awareness came in the form of not only VTEs and risk screening, but also EBP. While the physicians may not have considered VTEs a major problem, merely raising awareness of their likelihood may have subconsciously made an impact. Additionally, completing this EBP project and raising the awareness of the advantages of striving for up-to-date standards of care may allow for future EBP projects.

Limitations. Inherent with the nature of quality improvement projects, the precise controlling of variables, although ideal in experimental designs, was not the focus for this investigation. This project was conducted in a fluid environment. Conditions and variables were not constant. The patients were not the same, nor were the transplant physicians or their respective treatments. The metric for the outcomes was based on the incidence of VTE. This incidence was verified through findings in the medical record, notifications from other institutions, or by patient report. Given the time and resource constraints, there were no established interrater reliability or validity criteria for data collection. The data gathered was completed as a retrospective chart review.

CHAPTER 2. PROBLEM

Introduction

Thromboembolism is a common post-operative renal transplant complication. Studies have indicated this incidence can range from 7.9% to 9.1% (Poli et al., 2006; Verhave et al., 2014). Honolulu, Hawai`i's transplant center at The Queen's Medical Center (QMC) reported this complication at 5.6%. The purpose of this evidenced-based practice (EBP) project was to implement and evaluate a program that decreased the incidence of venous thromboembolism (VTE) in adult QMCTC patients following renal transplant surgery. This chapter will describe the conceptual framework used to organize the project, illustrate the literature search, critique, and synthesis process, and conclude with a recommendation for EBP change.

Conceptual Framework

Implementing change within a large organization required a systems-based approach. Titler et al.'s (2001) Iowa Model (see Figure 1) utilizes an algorithmic flowchart approach, which tracks project implementation and employs feedback loops. The first step of the model is the identification of triggers. After the literature search, critique, and synthesis, a decision must be made to assess the sufficiency of the evidence to develop a practice change. If a sufficient evidence base has been demonstrated, the practice change is then piloted, implemented, evaluated, and disseminated (Schaffer, Sandau, & Diedrick, 2012).

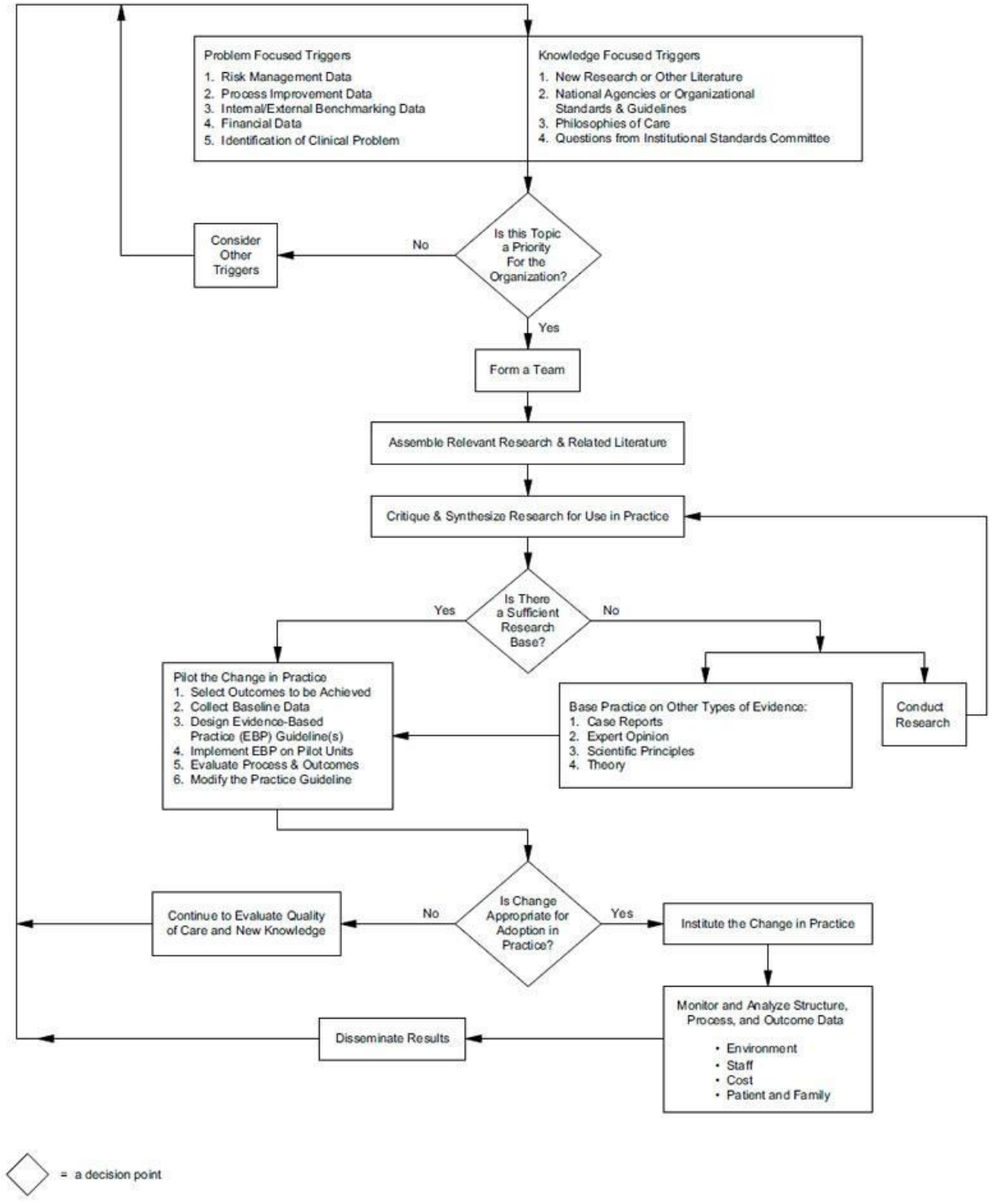

Figure 1. The Iowa Model for Evidence-Based Practice.
Note. From Titler et al. (2001)

Step 1: Identifying Triggers

The Iowa Model recommended the identification of triggers, which may be problem-focused or knowledge-focused. These triggers were designed to be the catalysts which stimulate critical thinking and inquiry into the development of possible EBP changes (Titler et al., 2001). Since 2014, The Queen's Medical Center Transplant Center (QMCTC) conducted 124 renal transplant surgeries. Seven cases of VTE were reported within six months after surgery—a 5.6% incidence. This was the trigger for this EBP project. While the incidence rate was below the literature rate, four reported VTEs within a year prompted the need for this project.

Step 2: Organizational Priority

VTEs are life-threatening. They affect nearly 900,000 people annually in the United States and kill roughly 300,000. They require longer hospital stays and/or hospital readmission. Costs resulting from VTEs have been estimated at $4.9 to $7.5 billion for deep vein thrombosis (DVT) and $8.5 to $19.8 billion for pulmonary embolism (PE) annually. Mean daily costs for DVT and PE patients are $1,594 and $1,735, respectively, per patient (Dasta et al., 2014).

Currently, there are no universally accepted VTE prophylaxis guidelines for renal transplant patients. During an investigation into the causes of the VTEs, a survey of QMCTC surgeons revealed varying VTE prophylaxis treatment plans based on individual surgeon experience and preference. Some favored only early ambulation and intermittent pneumatic compression (IPC), while others opted for pharmacologic interventions. For those who did not elect to prescribe antithrombotic pharmacologic therapy, concerns about hemorrhagic complications or a lack of support in the literature were noted.

Step 3: Team Formation

An interdisciplinary team of QMCTC staff was assembled to participate in this project (see Table B1 in Appendix B).

Step 4: Literature Critique and Synthesis

Although there was substantial literature for general surgical VTE prophylaxis, studies focused on renal transplant VTE were minimal. As such, search parameters were broadened to incorporate the different aspects of the project. The search was split up into several subtopics: VTE risk factors, VTE risk assessment, and VTE prophylaxis.

An electronic search was completed utilizing PubMed, CINAHL, Google Scholar, National Guideline Clearinghouse, and the Cochrane Library. Keywords and medical subject heading terms included permutations of: "kidney OR renal transplant*", "VTE", "venous thrombo*", "DVT", "deep vein thrombosis", "venous thromboembolism/prevention and control", "venous thrombosis/prevention and control", "deep vein thrombosis/prevention and control", "risk OR assess*", "risk", "risk manage*", "risk assess*", "risk factors", and "kidney OR renal insufficiency".

Articles were limited to publication within the last 20 years, English language, adult, and human subject results. No limits were placed on study design. Additional sources were identified using article reference lists.

Eighty-seven articles published between 1997 and 2016 were identified. Forty-four articles were omitted based on relevance to this project. Studies focusing on renal graft thrombosis and renal graft survival were also excluded. The remaining 43 were examined. In addition, the following guidelines and recommendations for VTE and DVT prophylaxis were reviewed: American College of Chest Physicians, Institute for Clinical Systems Improvement,

National Clinical Guideline Centre for Acute and Chronic Conditions, and American College of Physicians.

Evaluating the literature evidence. Mosby's Level of Evidence was used to grade the evidence and internal validity into one of eight levels (see Figure 2) (Melnyk & Fineout-Overholt, 2005). The grading results are shown in Figure 3. The "Other" level of literature included clinical practice guidelines (CPGs), reviews of CPGs, and literature reviews.

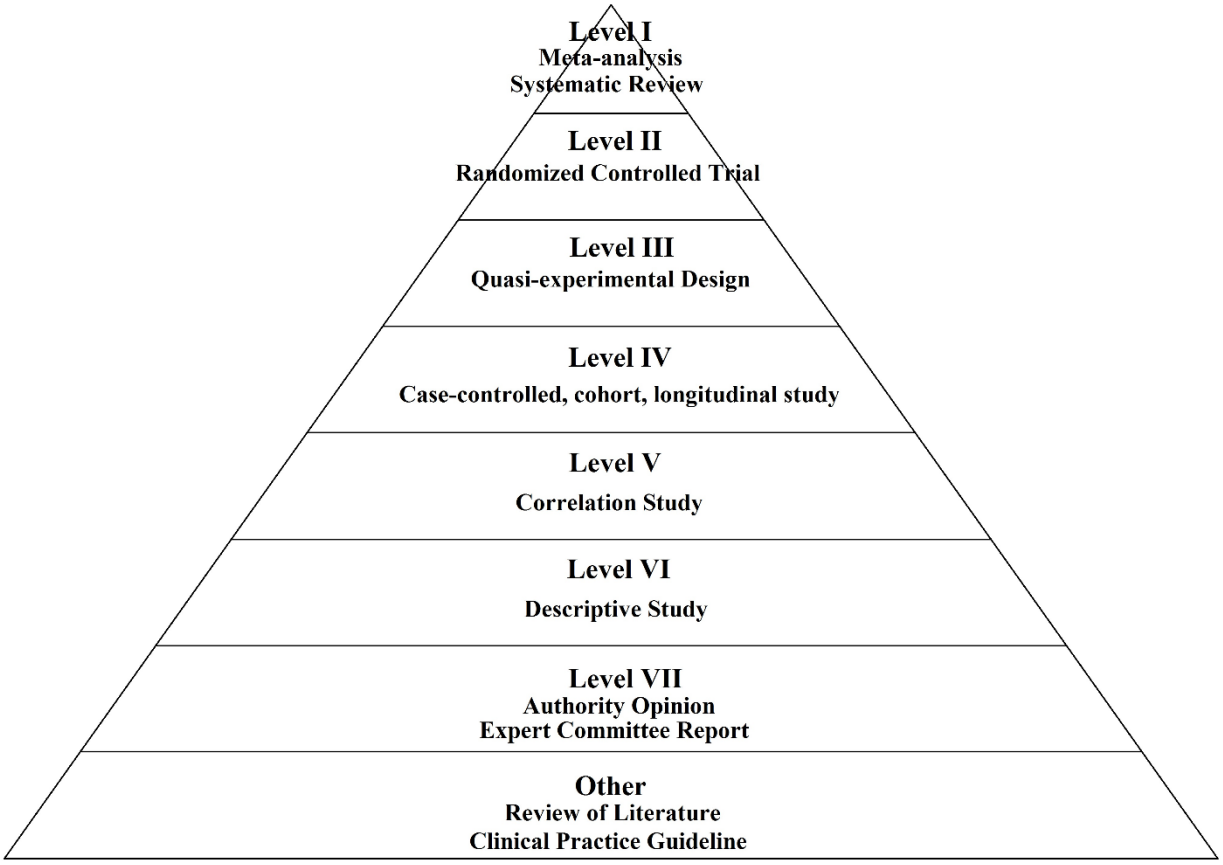

Figure 2. Mosby's Level of Evidence.
Note. Adapted from Melnyk & Fineout-Overholt (2005).

The CPGs were critiqued using the Appraisal of Guidelines for Research & Evaluation (AGREE) II instrument for the evaluation of CPGs (Brouwers et al., 2010). The AGREE II instrument uses a one to seven Likert ranking scale for 23 criteria in six domains: 1) Scope and purpose, 2) Stakeholder involvement, 3) Rigour of development, 4) Clarity of presentation, 5)

applicability, and 6) Editorial independence. For comparison and review purposes, the CPG scores were calculated out of a possible 161 points. The results of these scores as a percentage are shown in Table 1.

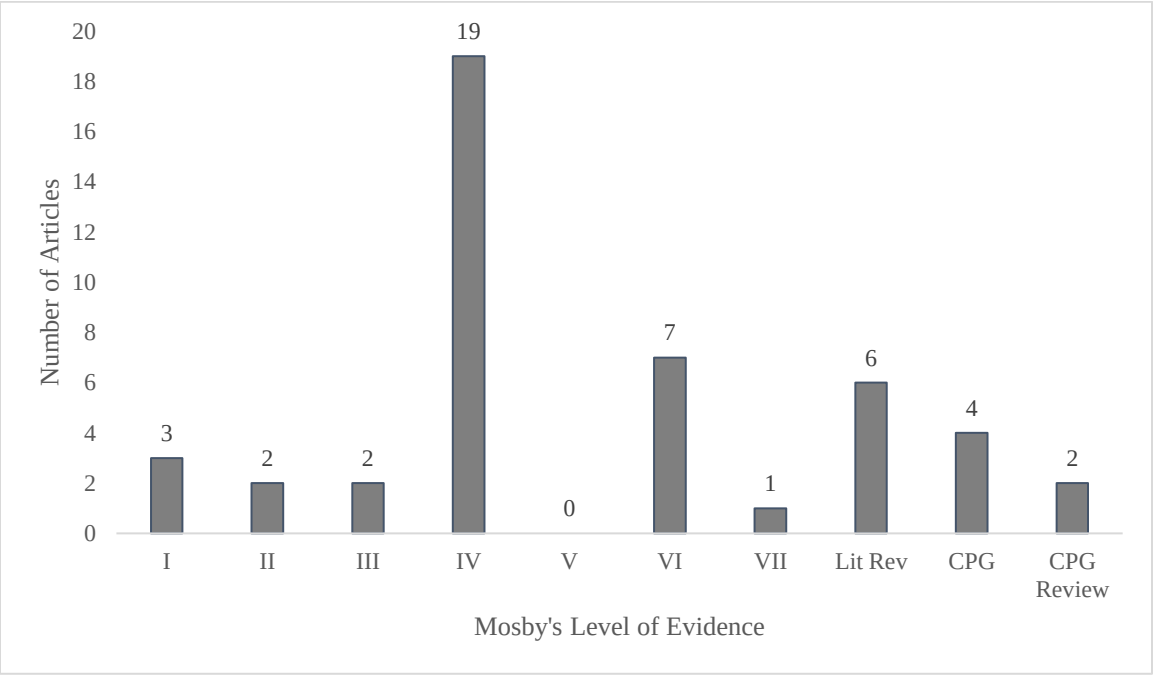

Figure 3. Number of Articles Reviewed and Mosby's Level of Evidence Rating.
Note. Lit Rev = literature review; CPG = clinical practice guideline

Table 1

Agree II Clinical Practice Guideline Scores

Reference	Score (%)
Gould et al. (2012).	89
Jobin et al. (2012).	84
National Clinical Guideline Centre for Acute and Chronic Conditions (2015).	86
Qaseem et al. (2011).	73

Note. Scores were calculated based on a total appraisal score divided by total possible score 161, rounded to the nearest whole number percentage.

Findings from the Literature Review

VTE Risk Factors. It was important to delineate between normal VTE risk factors and VTE risk factors in the renal transplant population. Wattanakit and Cushman (2009) examined the association between chronic kidney disease (CKD) and VTE. The researchers proposed hypercoagulation mechanisms in CKD, which included the activation of procoagulation factors, decreased endogenous anticoagulants, enhanced platelet activation and aggregation, and decreased activity of the fibrinolytic system.

Abbott, Cruess, Agodoa, Sawyers, and Tveit (2004) examined 28,924 patients receiving kidney transplants and found VTE was significantly more common in those with a low estimated glomerular filtration rate (eGFR) following surgery. In addition, other identified risk factors included hyperhomocysteinemia, frequent or prolonged hospitalization, sepsis, peritoneal dialysis over hemodialysis (HD), polycystic kidney disease (PCKD), and systemic lupus erythematosus (SLE).

Similarly, Folsom et al. (2010) reviewed 10,700 cases and compared the incidence of VTE with eGFR. Normal kidney function had a 1.0 hazard ratio with normal eGFR, 1.40 with mildly impaired kidney function, and 1.94 with Stage 3 to 4 CKD.

In a population of 95,154 patients, Mahmoodi et al. (2012) found, compared to an eGFR of 100 ml/min with a hazard ratio of 1.0, eGFRs of 75, 60, 45, and 30 ml/min were associated with VTE hazard ratios of 1.29, 1.31, 1.82, and 1.95, respectively.

Yagmur, Frank, Neulen, Floege, and Mühlfeld (2015) studied the prevalence of platelet hyperaggregation in patients with CKD—specifically comparing patients on HD and renal transplant recipients (RTRs) with healthy control patients. Sixty-seven percent of HD patients and 82% of RTRs exhibited platelet hyperaggregation.

In addition to CKD, other proposed mechanisms predisposing RTRs to VTE included hematologic and genetic risk factors. Irish and Green (1997) examined 38 RTRs and found increased prothrombin F1+2, d-dimer, and fibrinogen contributed to a hypercoagulable state.

Parajuli, Lockridge, Langewisch, Norman, and Kujovich (2016) reviewed the literature surrounding thrombosis following renal transplant. Inherited risk factors such as factor V Leiden mutation, prothrombin 20210G>A mutation, antithrombin deficiency, protein C or S deficiency, mutation in tissue plasminogen activator inhibitor-1 promoter, mutation of methylenetetrahydrofolate reductase, and increased lipoprotein all contributed to hypercoagulability. Acquired risk factors included antiphospholipid syndrome, hyperhomocysteinemia, cryoglobulins, cryofibrinogenemia, and acquired deficiencies of proteins C, S, and antithrombin. Disease states also contributory to hypercoagulability included disseminated intravascular coagulation, liver disease, nephrotic syndrome, and malignancy.

In describing general risk factors for VTE, Gangireddy et al. (2007) studied 118,258 surgical patients in the Veterans Health Administration system. Pre-operative risk factors associated with VTE included old age, male gender, corticosteroid use, chronic obstructive pulmonary disease, recent weight loss, disseminated cancer, low albumin, and low hematocrit. Post-operative risk factors included urinary tract infection, acute renal insufficiency, post-operative transfusion, myocardial infarction, and pneumonia.

Conversely, protective factors for symptomatic VTE included HD, diabetes, and higher pre-operative albumin levels. Humar et al. (1998) examined 1,833 RTRs and identified risk factors related to older age, diabetes mellitus, previous DVT, length of hospital stays, history of congestive heart failure, and increased body mass index. Proposed VTE etiologies included

pelvic dissection, venous anastomosis with clamping of the external iliac vein, decreased venous emptying secondary to position of the kidney, hematoma or lymphocele, and diabetes.

With respect to the timing and risk factors associated with VTE in RTRs, Todeschini et al. (2013) found DVT was more frequent five to eight months following transplant. Additional risk factors included cyclosporine or double therapy with cyclosporine and mammalian target of rapamycin inhibitor, PCKD, SLE, and nephrotic syndrome.

Verhave et al. (2014) also examined VTE risk following renal transplant surgery and found the incidence of VTE at one, five, and ten years was 3%, 5.8%, and 8.4%, respectively. The risk of VTE was eightfold in RTRs compared to the general population. Aspirin, eGFR, and proteinuria were not associated with thrombotic events. Risk factors included hospitalization, anemia, and use of sirolimus. Identified protective factors included the use of renin angiotensin aldosterone system (RAAS) inhibitors.

Zanazzi et al. (2005) evaluated the risk factors in RTRs for developing VTE after a first episode of recurrence. In 484 RTRs, 7% of the patients developed VTE and 50% developed a recurrence of VTE at a median time of 18 months.

In evaluating RTRs in Italy, Moscarelli et al. (2011) found thrombotic events occurred at a median of 17 months following surgery with 24% occurring during the first three months, 15.6% three to six months following, 9.4% six to twelve months following, 13.5% one to four years following, and 37.5% four years or more following surgery. Other risk factors included long-term steroid use, hyperhomocysteinemia, cytomegalovirus (CMV) infection, cancer, male gender, older age, type 2 diabetes, obesity, PCKD, lymphocele, and peritoneal dialysis prior to transplant.

Given Hawai`i's large Asian population, several studies noted a low prevalence of VTE in Asian patients. Yeo et al. (2015) found the incidence of VTE in Asian general surgery patients to be less than one percent. In comparing risk factors, the researchers found advanced stage cancer was the only independent risk factor. Other risk factors included age greater than 60, previous history of VTE, cardiovascular disease, immobilization greater than three days, post-operative complications, and having more than two comorbidities.

Similarly, Jun et al. (2014) evaluated the incidence of VTE in Korean RTRs and found a low prevalence. The researchers suggested the lack of factor V Leiden or prothrombin gene 20210A mutations, more prevalent in Caucasian populations, may be related.

VTE Risk Assessment. The literature described several VTE risk assessment tools. Most prominent were the Caprini, Padua, Kucher, and Rogers risk assessment models (RAMs). Caprini (2011) compared the relative strengths of the Kucher and the Anderson and Spencer RAMs. Caprini recommended VTE risk assessment be done as early and as soon as possible with a multidisciplinary team. Also emphasized was employing comprehensive and personalized VTE prophylaxis plans encompassing inpatient and post-discharge treatment.

Among the VTE RAMs, the Caprini model was the most widely used and validated in the literature. Liu, Liu, Chen, Wu, and Lu (2016) sought to compare the validity of the Caprini and Padua RAMs. The Padua RAM had a lower sensitivity, but higher specificity compared to the Caprini RAM. The Caprini RAM tended to place many of the patients into high to super high risk categories, without developing VTE.

Bilgi et al. (2016) found the Caprini RAM to be an economical, practical, and effective tool to stratify general surgical patients for perioperative VTE risk.

Lobastov et al. (2016) found a significant correlation between Caprini scores and the incidence of postoperative VTE in high-risk surgical patients. These results were also corroborated by other studies finding linear correlations between Caprini score and VTE incidence (Grant et al., 2016; Obi et al., 2015; Zhou et al., 2014).

The role of electronic medical records (EMRs) and VTE risk assessment has also been explored in the literature. Cassidy, Rosenkranz, and McAneny (2014) reviewed an EMR-integrated system requiring a Caprini VTE risk score for every surgical patient. Once a score has been inputted, the EMR generated a list of recommended prophylaxis regimens and durations. Surgeons could opt out of the recommended list, but were then mandated to indicate rationale.

Kucher et al. (2005) evaluated the use of a computer-alert program designed to encourage VTE prophylaxis. The researchers found a computer-alert reminder system reduced the risk of VTE by 41%.

In a review of an EMR assessment system, Galanter et al. (2010) evaluated a commercial EMR and clinical decision-support system (CDS). The researchers found a mandatory assessment for physicians to document VTE risk improved the rates of pharmacologic prophylaxis prescription and reduced the risk of VTE.

In another review, Pannucci et al. (2014) compared physicians' ability to accurately determine VTE risk compared to a computer-generated Caprini RAM program. Results showed physicians underestimated VTE risk by as much as six points compared to computer automation. Under-risk stratification by as much as two points was also significantly associated with VTE.

Cassidy, Macht, Rosenkranz, Caprini and McAneny (2016) evaluated VTE failures associated with their EMR-generated thromboembolism prophylaxis protocol. While the EMR risk stratification tool dramatically reduced the likelihood of VTE, the researchers analyzed the

VTE cases for causes of failure. The VTE events may have been related to prophylaxis inadequacies rather than improper risk stratification or missed medications.

VTE Prophylaxis. As there are no standardized prophylactic CPGs for renal transplant surgeries, much of the literature recommended individualizing therapy on a case-by-case basis. Gould and associates' (2012) American College of Chest Physicians CPG established a set of prophylaxis recommendations for general surgery patients based on risk category and either Rogers or Caprini score (see Table 2).

Table 2

Recommended Prophylaxis Regimens Based on Caprini Score and Risk Stratification

Caprini Score	Risk Category	Recommended Prophylaxis
0	Lowest	No specific pharmacologic or mechanical prophylaxis other than early ambulation
1-2	Very Low	Mechanical prophylaxis, preferably with IPC
3-4	Moderate, Low Bleed Complication Risk	LWMH. LDUH, or mechanical prophylaxis, preferably with IPC
3-4	Moderate, High Bleed Complication Risk	Mechanical prophylaxis, preferably with IPC
≥5	High, Low Bleed Complication Risk	LMWH or LDUH for 4 weeks with mechanical prophylaxis with elastic stockings or IPC
≥5	High, High Bleed Complication Risk	Mechanical prophylaxis, preferably with IPC
≥5	High, Low Bleed Risk Complication, LMWH and LDUH contraindicated	Low-dose aspirin, fondaparinux, or mechanical prophylaxis, preferably with IPC

Note. From Gould et al. (2012). IPC = intermittent pneumatic compression; LMWH = low-molecular-weight heparin; LDUH = low-dose unfractionated heparin

As part of an EMR program, Cassidy et al. (2014) developed a simplified recommended VTE prophylaxis regimen based on the Caprini RAM with stratification for higher Caprini scores and recommended chemoprophylaxis duration (see Table 3).

Table 3

Recommended Prophylaxis Regimens Based on Caprini Score and Risk Stratification

Caprini Score	Risk Category	Recommended Prophylaxis	Recommended Duration of Chemoprophylaxis
0	Lowest	Early frequent ambulation only OR at discretion of surgical team: Compression boots OR Low-dose heparin OR Low molecular weight heparin	During hospitalization
1-2	Low	Compression boots OR Low-dose heparin OR Low molecular weight heparin (Choose one item)	During hospitalization
3-4	Moderate	Compression boots AND Low-dose heparin OR Low molecular weight heparin (Choose one medication)	During hospitalization
5-8	High	Compression boots AND Low-dose heparin OR Low molecular weight heparin (Choose one medication)	7-10 days total
>9	Highest	Compression boots AND Low-dose heparin OR Low molecular weight heparin (Choose one medication)	30 days total

Note. From Cassidy et al. (2014).

Eng et al. (2011) examined the bleeding risks associated with perioperative anticoagulation or antiplatelet therapy. Preoperative aspirin therapy did not increase transfusion incidence. However, it tripled the risk of reoperation, whereas postoperative aspirin therapy doubled the risk. Post-operative heparin administration increased the risk of reoperation by 21-fold.

Similarly, Bakkaloglu et al. (2012) evaluated the necessity for heparinization following renal transplantation. In the early postoperative period, heparin did not significantly increase positive outcomes. Instead, early mobilization within 12 to 24 hours with anti-embolic compression socks was recommended.

As lymphoceles have been identified as a risk factor VTE following renal transplant surgery, Derweesh et al. (2008) sought to investigate the effect of placing prophylactic drains during transplantation. Intraoperative Jackson-Pratt (JP) drain placement in the extraperitoneal space dramatically reduced the incidence of VTE.

Jun et al. (2014) also compared mechanical prophylaxis interventions in addition to the routine use of an intraoperative JP drain. Patients treated with IPC devices were less likely to develop VTE compared to those treated with graduated elastic stockings.

Moscarelli et al. (2011) studied the effect of RAAS blockade and vitamin D medications as VTE prophylaxis interventions. Daily calcitriol, angiotensin-converting-enzyme inhibitor, and angiotensin II receptor blocker administration significantly decreased the risk of new VTE by as much as 60%.

Weaknesses, Gaps, Limitations

Although there was a sizeable amount of literature surrounding general VTE concepts, articles specifically related to VTE following renal transplant was limited. While the phenomenon has been noted in the literature, higher-level, large sample size studies have not been conducted. Many of the RTR-specific risk factors were based on Level IV retrospective cohort studies. Associations made in these articles were interpreted carefully as the may not have indicated causation.

Articles comparing VTE RAMs were also generally limited to the Caprini RAM and articles validating the use of the Caprini RAM. Standalone articles assessing the validity of other VTE RAMs were uncommon.

Another limitation was the applicability to the patient population at QMCTC. Six of the seven RTR VTE patients at QMCTC were Asian or part-Asian. Conversely, most the patient

populations in the studies included a predominantly Caucasian population. While a few of the studies were focused on the Asian population, higher level studies were unavailable.

Innovation/Objectives

The four CPGs provided a baseline for general care related to VTE. While not transplant- or renal transplant-specific, the CPGs recommended starting with some measure of assessment for VTE risk and risk of bleeding with appropriate prophylaxis intervention (Gould et al., 2012; Jobin et al., 2012; NCGCACC, 2015; Qaseem et al., 2011). Although not explicitly endorsing a specific RAM, Gould et al. (2012) listed the Rogers and Caprini RAM scores as a measure for appropriate prophylaxis interventions. Jobin et al. (2012) specifically recommended use of the Caprini RAM and outlined several interventions based on those scores. In the literature, the Caprini RAM was also the most widely used and validated. Studies evaluating the validity of the scores and value for predicting VTE events have received much support (Bilgi et al., 2016; Grant et al., 2016; Lobastov et al., 2016; Obi et al., 2015; Zhou et al., 2014). Mentions of other VTE RAMs were limited and generally cited in comparison with the Caprini RAM. One major drawback for the Caprini RAM was the high sensitivity and low specificity in predicting VTE (Liu, Liu, Chen, Wu, and Lu, 2016).

Based on its practicality and effectiveness, the project team decided to utilize the Caprini RAM. However, as many of the risk factors were already contraindications to transplant surgery or were applicable to all patients, a modified version of the RAM was required. Additional risk factors identified in the literature included decreased eGFR, inherited hypercoagulable factors, CMV infection, and peritoneal dialysis prior to transplant (Abbott, Cruess, Agodoa, Sawyers, and Tveit, 2004; Folsom et al., 2010; Gangireddy et al., 2007; Mahmoodi et al., 2012; Moscarelli et al., 2011; Parajuli, Lockridge, Langewisch, Norman, and Kujovich, 2016; Zanazzi et al.,

2005). While Parajuli et al. (2016) advocated for the pre-transplant screening of all patients for genetic or hypercoagulable risk factors, the prohibitive costs and the likelihood of incidence in the patient population did not justify universal screening (Jun et al., 2014; Yeo et al., 2015).

The objective for this project was to evaluate the effect of the VTE risk assessment program on VTE incidence in the QMCTC adult renal transplant population over a five-month period.

Summary

Chapter 2 covered the conceptual framework used to organize the project, the literature search, critique, and synthesis process, and recommended practice change based on the evidence. The Iowa Model was used as the framework to guide this project. Steps 1 through 4 were covered. These steps provided an overview of the identification of triggers, determination of organization priority, team formation, and the search, critique, and synthesis of the evidence. The triggers for this project were identified as the life-threatening and costly VTEs following renal transplant surgeries. To explore this subject, the literature was searched using a variety of databases and strategies. When searching the literature, the project was separated into three subtopics: VTE risk factors, VTE risk assessment, and VTE prophylaxis. Following the literature synthesis of four CPGs and 42 articles, the Caprini RAM appeared to be most widely used and validated VTE RAM. A modified version of the Caprini RAM was adapted to QMCTC's specifications. Redundant or not applicable risk factors were removed, while several other risk factors from the literature were added. Other novel VTE prophylaxis interventions were reviewed, but ultimately not considered due to the lack of high level, large sample size studies. The full details of the EBP implementation will be covered in the following chapter.

CHAPTER 3. METHODS

Introduction

A practice change at The Queen's Medical Center Transplant Center (QMCTC) required a carefully structured approach to ensure implementation. Following the literature synthesis and critique, the Iowa Model of evidence-based practice (EBP) shifted to a pilot of the practice change. The implementation of this pilot included the following steps: (a) selection of outcomes to be achieved; (b) collection of baseline data; (c) creation of EBP guidelines; (d) implementation of the guidelines in a pilot trial; (e) evaluation and of the pilot trial and outcomes; and (f) modification of the practice guidelines based on the results of the pilot study (Titler et al., 2001). This chapter will describe these steps in addition to a description of the design, implementation, and analysis.

PICO statement. To clarify the aims and objectives, the following problem, intervention, comparison, and outcome (PICO) statement, clinical question, and objective were developed.

Problem/Population (P): Venous thromboembolism (VTE) in adult renal transplant patients.

Intervention (I): VTE risk assessment in patients prior to renal transplant surgery.

Comparison (C): Current practice.

Outcome (O): VTE risk assessment for all patients prior to transplant and an overall decrease in the incidence of VTE.

Clinical question. Will the implementation of an evidence-based VTE risk assessment program decrease the incidence of VTE by one percent in the QMCTC adult renal transplant population over a five-month period?

Objective. The objective for this project was to evaluate the effect of the VTE risk assessment program on VTE incidence in the QMCTC adult renal transplant population over a five-month period.

Implementation Plan

Overview. This section will cover the EBP implementation plan, including a summary of EBP, sampling plan, and stakeholder engagement plan.

Evidence-based practice. EBP is the conscientious and judicious use of the evidence as guided by the literature (Titler et al., 2001). Utilizing Titler et al.'s (2001) Iowa Model, Steps 1 and 2 were the identification of triggers and organizational priority for the project. They were identified as the life-threatening and costly VTEs following renal transplant surgeries. The team formation of Step 3 was also completed. The literature search of Step 4 was then conducted to determine the sufficiency of a research base to support a practice change.

Practice change. At a QMCTC multi-disciplinary conference, a discussion was held on the feasibility and practicality of proposed practice changes from the literature. VTE risk factors, risk assessment models, and prophylaxis options were considered.

A modified version of the Caprini RAM was selected and adapted to QMCTC's specifications (see Appendix A). Redundant or not applicable risk factors were removed. Risk factors identified in the literature were added. The modified VTE risk assessment tool was administered to renal transplant patients prior to surgery. The results from the assessment was then forwarded to the transplant physician team.

Characteristics of the innovation.

Relative advantage. Rogers (2003) described the relative advantage of an innovation as the degree to which it is better than the idea it supersedes. In the pilot phase this project, the

feasibility of designing and implementing a VTE risk assessment program was the initial investment. As reimbursements for preventing readmissions are vital to the current economic model of health care, it was in the organization's best interests to prevent this occurrence. While the adoption required an initial investment, the cost/benefit analysis should have steadily become more favorable as more cases of VTE were prevented.

Compatibility. The compatibility is the degree to which an innovation is perceived as consistent with existing values, experiences, and needs of adopters (Rogers, 2003). This project furthered QMCTC's mission to extend and enhance the quality of life through the organization's commitment to excellence (Queen's Transplant Center, 2014a).

Complexity. The complexity is the perceived difficulty of an innovation's understanding and use (Rogers, 2003). In designing this project, one of the main priorities was to ensure transparency in both adoption and purpose.

Trialability. The trialability is the degree to which an innovation can be piloted on an experimental basis (Rogers, 2003). For this project, the risk assessment tool was administered by the team. The success of the project in achieving the expected outcomes may have influenced the permanent adoption of the VTE risk assessment program.

Observability. The observability is the degree to which an innovation is visible to others (Rogers, 2003). This project was a preventive innovation—an investment to reduce the probability of a future adverse event. These types of innovations are challenging to demonstrate to potential adopters. The purported advantages are intangible or may not even occur at all, making the immediacy of the incentives for adoption difficult to visualize. Additional stakeholder engagement and education must be completed to compensate.

Timeline. Following the literature search and synthesis as outlined in Chapter 2, the Iowa Model shifted into Step 5 – Pilot the Practice Change (Titler et al., 2001). This step included the selection of outcomes to be achieved, the collection of baseline data, the designing of EBP guidelines, the pilot implementation, the evaluation of the process and outcomes, and the modification of the practice guidelines. As seen in Figure 4, the proposed timeline for this project started in May 2017 and culminated in May 2018. Step 5 was completed by the end of July 2017. Subsequently, Step 6, or the full practice change implementation, began in August 2017. The implementation lasted for four months and concluded in November 2017. Step 7, or the evaluation of the outcomes of Step 6, took place throughout Spring 2018 and culminated with the final project defense in April 2018. In addition, stakeholder engagement was concurrently completed, as outlined in the next section.

Sampling plan.

Social systems. The Queen's Medical Center (QMC) is Hawai`i's largest private, non-profit acute care facility (QMC, 2017). This EBP Doctor of Nursing Practice (DNP) project was conducted at QMCTC—the only organ transplant center in Hawai`i and the Pacific Rim (Queen's Transplant Center, 2014b). The transplant center provides five transplant program including liver, adult kidney, pediatric kidney, pancreas, and living kidney transplant programs (Queen's Transplant Center, 2014c).

Sample.

Population and sample. The target population was the renal transplant patients undergoing the assessment. The intended users for this innovation were ultimately the transplant physicians. An informal, pre-implementation poll of the physicians showed skepticism and disinterest in adopting the innovation. Thus, the targeted users shifted to the nursing staff. The

results from each pre-transplant risk assessment was forwarded to the transplant physicians prior to surgery.

TASK	2017								2018				
	M	J	J	A	S	O	N	D	J	F	M	A	M
Submit Ch 1-3 to Committee													
Proposal Defense													
Brief Key Leaders & Staff													
Train Staff													
Collect & Update Baseline Data													
Pilot Practice Change													
Evaluate Pilot Change													
Modify Practice Guideline PRN													
Implement Practice Change													
Collect Data													
VTE Monitoring													
Analyze Data													
Interpret Data													
Submit Final Paper to Committee													
Final Defense													
Prepare & Submit Dissemination Products													
Graduation													

Figure 4. Proposed Project Timeline.

Due to the nature of VTE development in RTRs, timing was a critical factor. At QMCTC, the average length of time for the development of VTE for the eight VTE patients occurred on post-operation day 54.75, with a range of 15 to 112 days. QMCTC is most concerned with VTEs developing within six months following transplant.

Inclusion/exclusion criteria. Patients included in this project were all QMCTC RTRs age 18 years or older undergoing renal transplant surgery during the implementation period.

Application of users of the innovation. Adapted from Rogers (2003), preliminary role designations were made to stratify team members and stakeholders (see Table 4). Engaging these stakeholders is covered in the stakeholder engagement plan.

Change agents.

The project leader facilitates the project and establishes timelines, delegates work assignments, and oversees the overall process.

The opinion leader is both respected and influential among peers and is technically well-versed on the content material.

Change champions are informal leaders and have positive working relationships with their peers. They are committed to providing quality care for their patients.

Users are consumers of the innovation and can troubleshoot and report any challenges in the day-to-day usage (Rogers, 2003).

Adopter categories. As Rogers (2003) explained, discerning adopter categories is important in determining innovativeness, or the timing and openness to which an innovation is adopted. This innovativeness curve can be separated into five standard deviations: innovators, early adopters, early majority, late majority, and laggards.

The utility of differentiating between categories determines the strategies to influence the buy-in from those potential stakeholders. For example, the laggards, or the transplant physicians, may have used the intervention's results to better inform their practice. However, this group was skeptical and resistant to the applicability of the practice change to QMCTC. The challenging aspect in garnering their buy-in was the persuasion to adopt the innovation. Strategies for gaining their support needed to be tailored individually.

Table 4

Adopters, Role Designations, and Adopter Categories as Adapted from Rogers (2003)

Adopters/Roles	Adopter Categories
DNP Student	Project leader, innovator
QMCTC Manager	Opinion leader, early adopter
Transplant APRN	Change champion, early majority
Transplant Care Coordinator	Change agent, early majority
Transplant Pharmacist	Change champion, early majority
Transplant Staff	Users, late majority
Transplant Physicians	Users, laggards

Stakeholder engagement plan. As the Centers for Disease Control and Prevention (CDC) (2005) noted, stakeholders are key entities within an organization and are invested in the program and its results. Depending on how they are engaged, stakeholders can be supportive, through improving credibility, implementation, advocacy, or authorization, or detrimental, through resistance, opposition, or criticism. Stakeholders are also tasked with ensuring the CDC's four standards for evaluation—utility, feasibility, propriety, and accuracy—of the project's results. These standards were selected by the CDC to aid in the decision-making process as part of their framework for program evaluation (CDC, 2005).

The stakeholders for this project included a multidisciplinary team (see Table B1 of Appendix B). Per the Iowa Model, the specific engagement for individual stakeholders occurred

at different phases, depending on the support required. Tables B2 and B3 of Appendix B show an evaluation of stakeholder contribution to this project.

Based on Shirey's (2012) stakeholder analysis matrix tool, potential stakeholders were identified and sorted into categories based on four quadrants: manage, engage, tell, and consult (see Figure 5). The purpose of this stratification was to plot stakeholders based on their stake (horizontal axis) and influence (vertical axis) to strategically inform communication strategies for engagement.

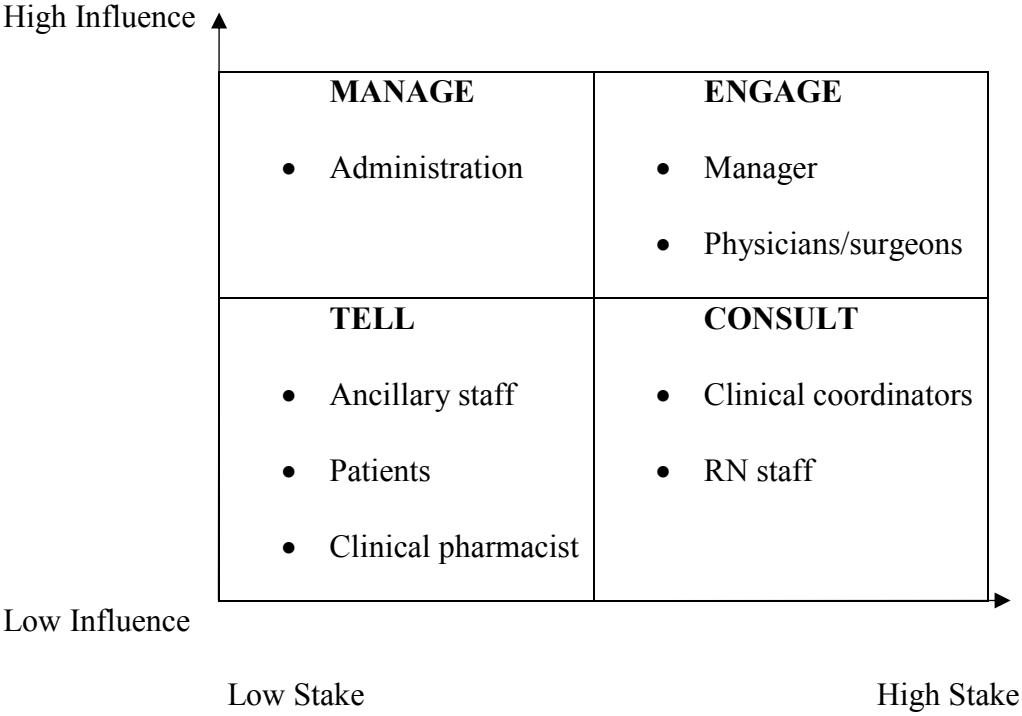

Figure 5. Stakeholder Mapping.
Note. Adapted from Shirey (2012).

The manage quadrant was comprised of stakeholders with high influence, but low stake in the project's outcomes. This included The Queen's Medical Center (QMC) administrators concerned with a successful result. The communication aim was to appease. Engagement for these stakeholders took place after the practice change has been finalized and submitted for administration approval.

The engage quadrant were those who were not only highly influential, but also had a high stake in the project outcome. This included the QMCTC manager, with a vested interest in the project and site operations, and the QMCTC physicians, skeptical about the utility of the project. The goal was open communication. With the respect to the Iowa Model, QMCTC manager engagement began from the project's inception and continued to the conclusion.

The tell quadrant were those with both low influence and low stake in the project's results. While they played an integral role in the daily operations of QMCTC, they did not have a pivotal role in the project. Communication was one-way. Engagement with the clinical pharmacist and ancillary staff occurred during staff training prior to the pilot implementation.

The consult quadrant were stakeholders with low influence, but high stake in the project. The task was to inform and provide two-way communication. This group had direct patient contact and included the nursing staff and clinical coordinators. They were instrumental in the implementation of this project. Their engagement began during the staff training period prior to the pilot process and continued throughout the implementation.

Application of communication processes. Rogers (2003) described mass media as having the advantages of reaching large audiences rapidly, disseminating information, and changing weakly-held attitudes. Interpersonal channels have the advantages of a personal, two-way exchange of information. This allows for the possible persuasion of resistant or apathetic individuals. Using a concerted approach with both mass media and interpersonal channels is an effective strategy to reach a sizeable portion of an organization. With unlimited resources, a combination of emails, multimedia presentations, and visual posters would be incorporated. Following, the use of interpersonal channels should be used to target laggard, higher-yield

adopters. In-person meetings with potential laggard adopters should be held to host an exchange of ideas to address any concerns.

Given time and resource constraints, a simplified and feasible communication process was deemed necessary. Drawing on Gagnon's (2011) guidelines, effective knowledge dissemination requires several considerations. First, the content of the message should be straightforward, action-oriented, and tailored specifically for its intended audience. Next, the source or messenger should be reputable, credible, and influential with the target audience. With these guidelines in mind, sustainability was dependent on the buy-in from key influential stakeholders. Other proposed communication strategies for sustainability were informational training sessions and project-related email updates.

Evaluation Plan

Evaluation question. The evaluation question for this project was: Will the implementation of an evidence-based VTE risk assessment program decrease the incidence of VTE by one percent in the QMCTC adult renal transplant population over a five-month period?

Integrity of the evaluation design. The evaluation plan utilized the CDC's framework for program evaluation. As Milstein and Wetterhall (2000) described, the CDC framework encompasses six steps: 1) Engage Stakeholders; 2) Describe the Program; 3) Focus the Evaluation Design; 4) Gather Credible Evidence; 5) Justify Conclusions; and 6) Ensure Use and Share Lessons Learned. Guiding these six steps were the CDC's four underlying standards: utility, feasibility, propriety, and accuracy. These standards were designed to maintain the evaluation plan's accountability and ensure the validity and integrity of the results (Milstein & Wetterhall, 2000).

Utility. The results of the evaluation were directly used by several stakeholders. If the outcomes of the project were fulfilled, QMCTC physicians will have had the requisite evidence leading to a permanent practice change and paving the way for additional funding and authorization to implement an EMR-based risk assessment tool.

Feasibility. The project's implementation was relatively nonintrusive and required little in terms of time or resources. It was designed to be seamlessly integrated into the existing QMCTC workflow.

Propriety. The project was conducted with strict observance of all patient privacy laws and regulations. The necessary HIPAA and privacy training were completed. Stakeholders from the various levels of influence and stake in the project were engaged per the stakeholder engagement plan.

Accuracy. The accuracy of this project was demonstrated through adherence to project parameters. Interdisciplinary team members and stakeholders were engaged and invited to oversee the project. They ensured data collection, storage, and analysis were being completed through systematic, valid, and reliable means.

Program description. The microsystem within QMCTC consisted of QMCTC staff, or the frontline providers of care including the transplant physicians and nurses, and the RTRs, or the recipients of care from the program. For the purposes of this project, the program of care was separated into four phases: the pre-transplant phase, the surgery phase, the inpatient post-surgery recovery phase, and the outpatient post-discharge phase.

Current practice. The pre-transplant phase consisted of the pre-surgery consults. During this phase, the transplant physicians independently conducted their pre-surgery VTE risk assessment measures. Prior to the start of the project, there was no formal, standardized risk

assessment tool utilized by the providers. The intervention was conducted during this phase. After the necessary preparations, the patients underwent transplant surgery.

New practice. The practice change was designed to take place during the pre-transplant phase. During this phase, the adapted Caprini VTE risk assessment was administered to all renal transplant patients. Subsequently, the assessments were forwarded to the transplant physicians. The intent was to provide a standardized and comprehensive assessment for each patient. The data collection monitored VTE incidence during the inpatient post-surgery recovery and outpatient post-discharge phases.

Anticipated impact on staff and patients. The intervention resulted in an added assessment step for staff during the pre-transplant phase. Patient medical records were reviewed for pertinent history. In-person interviews were conducted to verify information and gather details not present in the record. From the patient perspective, the intervention may have appeared as additional routine screening prior to surgery.

Definitions. This project examined the effect of a VTE risk assessment screening program on the occurrence of VTE in QMCTC adult renal transplant patients. The evaluation design was impact and pre-test/post-test.

The incidence of VTEs required a verified diagnosis in the medical record. VTEs were defined as encompassing both DVT and PE (Lip & Hull, 2017). DVTs were the presence of coagulated blood, or a thrombus, in the deep venous system most commonly in the lower extremities (Patel, 2016). PEs were blood thrombi that usually originate from the deep venous system and migrate to the lungs leading to possible hemodynamic compromise (Ouellette, 2016).

Baseline. The collection of baseline pre-test data at T1 consisted of examining the number of RTR VTE incidences in the medical record prior to implementation. In addition, the

QMCTC physicians were surveyed on their thoughts about the topic and program (see Appendix C).

Intervention. The intervention was the administration of a QMCTC-modified Caprini VTE risk assessment tool administered to renal transplant patients during the pre-transplant phase.

Process measures. The process measure was the total number of RTRs screened. In addition to screening the prospective renal transplant patients, one of the transplant physicians proposed monitoring the change (if any) in VTE prophylaxis prescription as compared to previous prescription practices. This proposal was considered, however, the project team deemed this too research-intensive for a QIP to not only retroactively examine physicians' past prescription practices, but also screen past RTRs for VTE risk factors.

***Outcome measures at T2*.** The outcome measure was the incidence of VTE in RTRs. The operational definition was incidence of VTE (DVT or PE) during the five-month implementation period determined by medical record diagnosis or reported hospitalizations. Following the completion of the intervention at T2, VTE incidence was expressed as the overall incidence of VTEs since 2014 (total number of VTEs divided by the total number of renal transplants performed) and incidence during the implementation period (total number of VTEs during the implementation period divided by the total number of renal transplants performed during the implementation period).

The evaluation objective was set at 4.6%—one percent less than the baseline VTE incidence prior to implementation.

QMCTC providers were surveyed following the conclusion of the project on their thoughts about the program (see Appendix D).

Sample. The sample population included all QMCTC RTRs age 18 years or older undergoing renal transplant surgery during the implementation period. All patients who fit the inclusion criteria were included in the sample.

Mediating factors. As the implementation duration for this project was five months, there was the possibility of VTE development following the conclusion of data collection. VTEs may also have occurred during the implementation period, even though those patients underwent surgery prior to the start of this project. These factors were addressed and labeled accordingly in the results section.

Data management plan. The data management plan was critical to ensure the data collection procedures were strictly observed, the results gained were accurate, and the analysis was sound. The integrity of the data management process demonstrated the credibility of the project's outcomes to stakeholders. This required routine engagement of stakeholders, through providing a constant line of communication to foster inclusivity and transparency.

To ensure data quality, steps were taken to maintain the veracity. The data collection process was streamlined to allow only a few trained team members to collect data. The training took place during sessions prior to implementation. Training emphasized the purpose and aims of the project, the use of the tools, and the information collected. Employing a select few to collect, input, and analyze the data was intended to reduce errors attributed to ineffective training or team members out of agreement. Much of the data management was completed by the project leader. While this may not have been ideal to ensure interrater reliability, it was necessary given the limited time, resources, and EBP-centered design of this project. Every effort was taken to safeguard the quality of the data.

Data sources. The source of the data was the medical record with additional information obtained from patient report and transplant physician survey.

Data collection. During the screening process prior to surgery, each renal transplant patient's medical record was searched for risk factors as indicated by the risk assessment tool. Any information not available or unclear from the medical record was asked to the patient directly. Each patient was assigned a number and a risk assessment file. Identifying information was not recorded. A summary of each patient's VTE risk assessment was forwarded to the transplant physicians as they were screened.

For the incidence of VTE, data was obtained from the medical record or by patient report and verification. A spreadsheet recorded each patient's risk assessment. In the event of a reported VTE, the number of days post-operation to incidence was recorded. All information was stored on an encrypted database at QMCTC. Access was only available to authorized team members.

Data analysis. Following the data collection period was data analysis. Patients were individually analyzed based on risk assessment. In the event of VTE, the patient's risk assessment score, risk factors, and pertinent treatment information was analyzed to determine a correlation. Descriptive statistics used to analyze the data included total count, range, and average.

Stakeholders were invited to participate during the data analysis and interpretation process. Their input and participation increased transparency and ensured the quality of the results.

Resources

This project was not projected to require a large allocation of resources. As it was a quality improvement project, it was designed to be implemented with the least amount of

disruption to normal services as possible. The administration of the VTE risk assessment tool was not expected to significantly increase the time spent per patient. Although minimal, the time spent engaging stakeholders throughout this project should be noted.

Financial resource allocation was negligible. Other than negligible staff time, minimal additional expenditures were anticipated.

Human resources, or staff involvement, was on a voluntary basis with no mandatory expectations. Most of the data collection and analysis were done by the DNP student.

Physical space or other equipment was not projected apart from a spare computer terminal for data collection and management.

Dissemination Plan

Following data collection and analysis, the next Iowa Model step was the dissemination of results. During this period, the results of the implementation were presented to the stakeholders, the organization, and the scientific community. For this project, the audience was primarily the QMC stakeholders with a vested interest in the results of the project—QMCTC staff, transplant physicians, and QMC administrators. The decision to adopt the practice change permanently at QMCTC was heavily influenced by the project's ability to demonstrate achievement of the intended outcomes. Thus, the sustainability of this practice change was dependent on the results. Unsuccessful outcomes demonstrated the ineffectiveness and lack of applicability to QMCTC. Successful outcomes allowed for lobbying QMC administration in securing the necessary funding and authorizations required to make the practice change permanent. This project may have also served as a pilot for not only QMCTC, but also other QMC units affected by VTEs.

Human Subject Considerations

This EBP project was designed to be a quality improvement project (QIP) with the primary objective to protect the rights of the human subjects involved. As this was not a controlled trial, there were no plans to randomize subjects to different treatments or to collect identifiable information. Any information gathered from retrospective chart reviews was de-identified and encrypted. Standard evidence-based practices were implemented. Other than the risk associated with standard practice, there was no additional risk to the subjects. All patients meeting the adult renal transplant inclusion criteria were eligible for this project. Patients were not assigned to treatments, nor were any protected groups targeted. There was no additional risk to patients or staff beyond standard practice. Steps were taken to ensure there were no risks to patient or staff confidentiality.

The four ethical tenets—autonomy, non-maleficence, beneficence, and justice—were observed to ensure the project was ethically sound.

With respect to autonomy, both the transplant patients and providers could opt out of participating in the project. The patients were not mandated to provide any information via the risk assessment tool. Similarly, the providers were not obligated to use any of the risk assessment data to influence their practice.

With non-maleficence in mind, this project was not designed to cause any additional harm other than usual care. The transplant providers only received VTE risk assessments. They were solely responsible for prescribing treatments.

Beneficence was observed as every patient's risk for VTE was elucidated. The patients may have benefited from a thorough VTE risk assessment. The providers may have benefited

from receiving a more complete clinical picture without expending time to conduct a detailed chart review.

Justice was maintained through the relatively broad inclusion and exclusion criteria. Patients need only have been over the age of 18 to be included in the project.

The DNP student completed the University of Hawai`i Collaborative Institutional Training Initiative (CITI) course on Human Subjects Protection. In addition, a project application was approved by the Queen Emma Nursing Institute (QENI)—the program charged with promoting nursing excellence and overseeing QIPs at QMC (QENI, n.d.). Further approval was also granted by QMC Office of Research and Developmental institutional review board.

Limitations

The precise controlling of variables, although ideal in experimental designs, was not the focus for this investigation. This project was conducted in a fluid environment. Conditions and variables were not constant. The patients were not the same, nor were the transplant physicians or their respective treatments. Any conclusions drawn from the results of this project were considered correlational.

Due to the already small renal transplant population size, any restrictions accounting for distribution or representativeness would further reduce the sample size. This necessitated broad inclusion criteria and convenience sampling.

The metric for the outcomes was based on the incidence of VTE. This incidence was through verified diagnosis findings in the medical record, notifications from other institutions, or by patient report. Given the time and resource constraints, there were no established interrater reliability or validity criteria for data collection.

There were several possibilities for false negative results. First, if a VTE diagnosis was not noted in a patient's record during the data collection period, the incidence may have gone unrecorded. Next, a patient may have suffered from a VTE and sought treatment from an institution outside the QMC system. If the outside institution or the patients did not report this incidence to QMCTC, it may not have been recorded. Finally, there was also the possibility of the incidence of asymptomatic VTEs. Due to resource constraints, periodic post-surgery universal ultrasonography screening was considered, but deemed not financially feasible.

The data gathered was completed as a retrospective chart review. The quality of the data was largely dependent on health care providers' entries into the medical record. Procedurally, there was a variable timing of data collection as the renal transplant patients were screened.

Summary

The purpose of this DNP project was to decrease the incidence of VTE in the QMCTC adult renal transplant population following surgery. This chapter served as an overview describing the process to transition from the theoretical to a quality improvement practice change. In this chapter, the procedures for Step 5 of the Iowa Model, the piloting of the practice change, Step 6, the practice change implementation, and Step 7, the evaluation of project outcomes were described. The sampling plan was also illustrated, including the users of the innovation, key categories for stakeholders, the social system, and sample. Plans for stakeholder engagement were presented, along with the communication strategies, such as in-person meetings or emails to be utilized. A program evaluation plan modeled on the CDC's framework was also introduced. Finally, the resources, dissemination plan, human subject considerations, and limitations were explicated.

CHAPTER 4. RESULTS

Objective

The objective for this project was to evaluate the effect of the VTE risk assessment program on VTE incidence in the QMCTC adult renal transplant population over a five-month period. A standardized VTE risk assessment tool was created. The widely-validated Caprini tool was selected from the literature and adapted to QMCTC's specifications. The tool was then used on all adult renal transplant patients. The effect of the VTE risk assessment program was measured through VTE incidence.

Step 5: Practice Change Pilot

With the necessary resources and team members in place, the project was piloted for one month in August 2017. Due to the time-critical nature of transplant services, the team decided it would be most efficient for the DNP student to conduct all VTE risk assessment screenings. The narrow period between organ procurement, obtaining consent, and actual surgery left little time for the staff to implement this project.

Step 6: Practice Change Implementation

The full practice change implementation was conducted for four months following the pilot period. After QMCTC received notice of possible organ availability, prospective organ recipient matches were notified and brought in for consent. In the succession of pre-transplant processing involving consent, social work, and finance, the DNP student was allowed a brief window to speak with patients to complete the VTE risk assessment screen. Depending on the amount of information gained from the medical record, the total time spent with each patient was on average under three minutes. Data was collected as outlined in the Data Management Plan of Chapter 3. Following the VTE screening, transplants were not conducted in many of the cases

due to unsatisfactory organ quality, unavailability of the organ, or insufficient status on the recipient waitlist.

Step 7: Evaluate Outcomes

Description of sample. Twenty-two patients were potential candidates for renal transplant during the implementation period. Twenty-one of those patients were above the age of 18 and met inclusion criteria and underwent VTE risk assessment screening. Twelve of those patients underwent renal transplant surgery. The patient numbering scheme reflected the original order the patients were screened with consideration to those who did not undergo transplant. The data from those patients who did not undergo transplant was omitted from the results. Eleven of the patients were male (92%). The average age of the patient population was 49 years (range 28 to 68 years), with four patients each in the under 40 years, 40 to 60 years, and above 60 years age groups. Most of the patients were Asian or part-Asian (92%), while 17% of the patients were Caucasian or part-Caucasian (see Figure 6).

Level 1 Risk Factors. The most predominant Level 1 Risk Factors were age 40-59 years (33%) and major surgery (25%). One patient had swelling in his leg due to recent surgical revision of an arteriovenous graft (8.3%) (see Table E2 of Appendix E).

Level 2 Risk Factors. Age 60 to 74 years was the only Level 2 Risk Factor (33%) (see Table E3 of Appendix E).

Level 3 Risk Factors. There were no Level 3 Risk Factors identified in the sample population, although one patient's family history for DVT or PE could not be assessed as he was adopted (see Tables E4 and E5 of Appendix E).

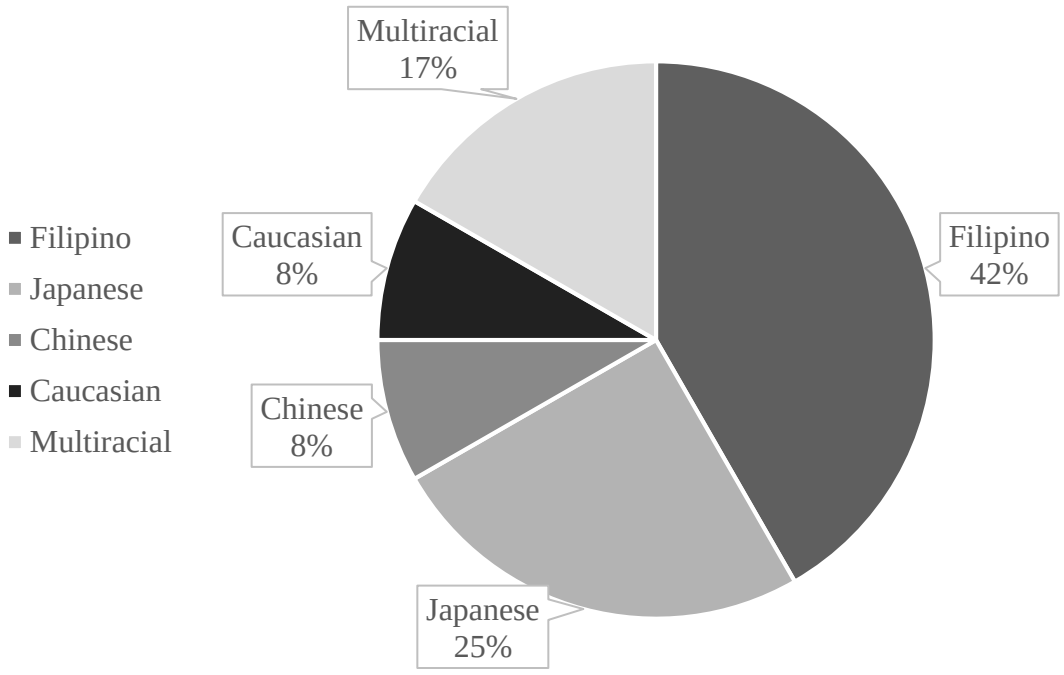

Figure 6. Renal Transplant Recipient Self-Reported Ethnicities.
Note. Multiracial included those of more than one ethnicity. The ethnicities for the two multiracial patients were Hawaiian, Filipino, and Japanese and Samoan, Portuguese, and Japanese.

Literature Risk Factors. For literature risk factors, one patient was on peritoneal dialysis (8.3%). Low hematocrit (less than 40% for males and less than 36% for females) was identified in 92% of the patient sample (range 28.8% to 39%) (see Table E6 of Appendix E).

Trend analysis for process and outcome measures.

Process measures. The process measure for this project was the total number of RTRs screened. Twelve of the total twelve renal transplant patients meeting the inclusion criteria were screened prior to surgery.

Outcome measures. Outcomes for this project were measured by the incidence of VTE in the RTR population. During the five VTE checks at the end of August, September, October, November, and December 2017, zero incidence of VTE was noted in the RTR records. The VTE

incidence rate in the RTR patient sample was 0%. The overall incidence rate since 2014 decreased from 5.6% to 5.1%.

Transplant physician survey. QMCTC transplant physicians were provided with surveys before and after the implementation period (see Appendices C and D, respectively). The response rate for the pre-survey was 60%, while the post-survey was 40%.

In the pre-survey, the respondents indicated VTEs were a minor problem at QMCTC (100%). Each physician felt differently on the priority to assess patients for VTE risk prior to transplant—medium priority (33%), high priority (33%), and essential (33%). The physicians were also neutral (33%), somewhat comfortable (33%), and very comfortable (33%) with their comfort in assessing VTE risk. All the physicians indicated they considered, but did not use a validated VTE risk assessment tool (100%). Regarding the project, the physicians noted the usefulness of the project to their practice would be slightly useful (33%), somewhat useful (33%), and very useful (33%). When asked on who should complete VTE risk assessments, the physicians felt the transplant nephrologist (33%), transplant APRN (33%), and transplant patient care coordinator (33%). On the likelihood of continuing to use a VTE risk assessment tool, the physicians indicated they would be neutral (33%), likely (33%), and extremely likely (33%).

In the post-survey, the physicians noted the information from the project was slightly useful (50%) and somewhat useful (50%). With regards to the effect on their prophylaxis decisions, the physicians indicated there was a neutral influence (100%). The physicians were neutral (50%) and somewhat favored (50%) the notion of continuing the project's VTE screening.

Evolution of Project

Expected vs. actual outcomes. Outcomes for this project were expressed as the incidence of VTEs in the RTR population and additionally physician support for the project. It was expected the incidence of VTE would be zero following the implementation period and the incidence rate of VTE would decrease by one percent. It was also expected there would be roughly five to eight renal transplant patients per month based on numbers from previous years. Following the conclusion of the project, the actual number of VTEs was zero, meeting expectations, however, the actual decrease in VTE incidence rate decreased by only 0.5%. The actual patient sample was smaller than expected. Over the course of the five-month implementation period, there were only 12 renal transplant patients who underwent surgery. While there was nearly double the number of patients screened, most of those did not undergo surgery due to unsatisfactory organ quality or insufficient priority status on the recipient list.

Physician support for this project had been neutral and pessimistic since its inception. Their skepticism on the need from a project was evident in their pre- and post-surveys. It was expected the information gathered from the project would support the continued usage of the VTE risk assessment program created. In practice, the period between organ availability notification to transplant surgery was very narrow. It was understandable the physicians most likely were not able to check their email for VTE risk assessment reports. A limited patient pool coupled with correlational results did little to provide further support for this project.

Facilitators. The staff of QMCTC were integral to this project. Although the demanding nature of their work prevented them from conducting screenings, their enthusiasm and willingness to provide other assistance aided in the project's completion.

Barriers. The negligible budget for this project was one of the key limiting factors for this project. With adequate funding, staff may have been compensated to complete the VTE screening. Additional barriers included the lack of EMR-integrated support for the screening program. The DNP student also did not have full EMR access with the ability to create notes in the EMR to relay screening data.

Summary

Chapter 4 included the Iowa Model steps 5, 6, and 7. These steps outlined the pilot of the practice change, the implementation of the practice change, and the evaluation of outcomes.

The QMCTC VTE risk assessment program screened a total of 22 patients over a five-month implementation period. Only 12 of the 22 patients underwent renal transplant surgery. Among the RTRs, age 40 to 59 years and prior major surgery made up the most common Level 1 Risk Factors. Age 60 to 74 years was the only Level 2 Risk Factor. There were no Level 3 Risk Factors identified. Low hematocrit was the most common literature risk factor identified.

Among the QMCTC physicians, VTEs were thought of as a minor problem and they considered, but did not currently use a validated VTE risk assessment tool. The physicians were also neutral on the effect of the project's VTE screening information on their prophylaxis prescription practices.

CHAPTER 5. DISCUSSION

Interpretation of Findings

VTE incidence. Representing one of the primary outcome measures for this project, VTE incidence was closely monitored throughout the implementation period. The calculated VTE incidence rate for this project was a 0.5% decrease, which was less than the outcome goal set at 1%. This goal was arbitrarily based on the projected average number of renal transplant surgeries conducted per month in the past. With a decrease in the number renal transplants, there was a proportionate decrease in the calculated VTE incidence rate. The total number of renal transplants was far less than the estimated figures, contributing to a smaller decrease in incidence rate.

Although there was only a 0.5% decrease in the overall VTE incidence rate, the savings in possible VTE aversions to QMC can be calculated. Using the figures of Dasta et al. (2014), with an average length of stay of 5.1 days and an average daily cost per patient of $1,664, a 0.5% decrease amounts to a savings of $5,770. In addition, for every VTE readmission averted, it saved QMC approximately $8,486.

As QMCTC was only concerned with VTEs that occurred in the six months following transplant, the sample population should have also been followed for six months. However, due to time constraints, the full VTE observation period post-surgery was not completed. The longest observation period was four months, while the shortest was one month. It was possible, following the conclusion of this project, VTE cases may still have developed, altering the VTE incidence rate. Other possibilities were unrecorded VTEs who sought treatment outside the QMC system or asymptomatic VTEs.

The correlational value of the decrease in incidence rate must be interpreted cautiously. Numerous factors may have contributed to this apparent decrease. Without a full retrospective chart review examining the variables contributing to the decrease, a definitive, causal connection between the effect of this project and the incidence rate cannot be assumed.

Transplant physician survey. The other outcome measure was based on the transplant physician pre- and post-surveys. The low response rates for the survey may have been indicative of the waning interest in the project. Three out of five (60%) and two out of five (40%) physicians participated in the pre- and post-surveys, respectively. While the response rates may have been low, those who responded provided valuable insight and feedback. As indicated by all respondents, VTEs at QMCTC were a perceived minor problem. This may have been a result of the time difference between cases. There have been no recorded cases of VTE in the RTR population since May 2, 2016. Prior, there was only one case on March 3, 2016. There were no VTE cases in 2015 and four cases in 2014 in January, February, October, and December. This clustered nature of incidence coupled with long periods of no incidence may have contributed to the physicians downplaying the severity of the problem.

However minor, the physicians still felt screening for VTEs was necessary on a medium to essential priority, suggesting a possible need for this project. Yet, in the post-survey, the physicians were indifferent to the usefulness of the information gathered and felt it had a neutral influence on their prescription decisions. The sustainability of the project will largely be dependent on the support from the physicians. If they did not use the risk assessment screen information, then the effort and energy expended on gathering the information was wasted.

Implications and Recommendations

Recommendations from this EBP quality project included adding the QMCTC-modified Caprini tool to the routine pre-transplant process. As expected, the administration of the VTE tool did not significantly increase patient contact time. Coupled with the estimated savings of $8,486 and relatively low cost to implement, QMC administrators should consider continuing this screening program. To expedite information entry, an EMR-based approach needs to be developed. Possible options include an EMR checklist in each patient's record or logging the results of the VTE tool screen in a note. Utilizing the EMR should make the information more conveniently accessible for physicians.

Per physician recommendation, the VTE risk assessment screen should be completed by the transplant nephrologist, transplant APRN, or transplant patient care coordinator prior to surgery.

One key implication following the implementation of this project was raising awareness. Awareness came in the form of not only VTEs and risk screening, but also EBP. While the physicians may not have considered VTEs a major problem, merely raising awareness on their likelihood may have subconsciously made an impact. Additionally, completing this EBP project and raising the awareness of the advantages of striving for up-to-date standards of care may allow for future EBP projects.

Although out of the scope of this quality improvement project, a retrospective analysis of every RTR since 2014 should be conducted. In this review, patients should be screened for VTEs using the QMCTC-modified Caprini tool cross-referencing risk assessments with postoperative VTE prophylaxis care. As suggested by one of the physicians in their post-survey, the prophylaxis prescription practices of the physicians should also be compared pre-project

implement and post-implementation to note any changes in practice to quantify a change in awareness.

DNP Essentials

The American Association of Colleges of Nursing (AACN) (2006) developed a set of essentials critical for all Doctor of Nursing Programs. These essentials are the core competencies required for all advanced nursing roles. A summary of the AACN essentials as they aligned with this project is presented in Appendix F.

Plans for Dissemination

The results will be disseminated via several methods including oral presentations, briefs, and formal written publications. These methods will report the project findings to various audiences including QMC stakeholders and the transplant community. The dissemination of information represents a critical aspect to contributing new knowledge to the existing body of literature. Other institutions may examine the outcomes and learn from the challenges and improve upon this project to ultimately provide quality, evidence-based care for patients.

Summary

Chapter 5 interpreted the results generated by this EBP quality improvement project. Following the implementation of the VTE risk assessment program, the overall VTE incidence rate decreased. While not a direct causative correlation, the results may have had an indirect effect of raising physician awareness on VTEs and EBP. Recommendations to increase the sustainability of this program were discussed, including the addition of the risk screen to the existing pre-transplant preparation process and streamlining the information dissemination through EMR integration. The AACN DNP Essentials were also described as they aligned with

this project. This chapter closed with plans for disseminating the findings of this project for the benefit of the organization and transplant community.

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Appendix A

Modified Caprini Venous Thromboembolism Risk Assessment Tool

Level 1 Risk factors (1 point)

- Age 40-59 years
- History of prior major surgery
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI >30)
- Abnormal pulmonary function (COPD)
- Leg plaster cast or brace
- Blood transfusion (<1 month)

Level 1 Risk factors for women (1 point)

- Oral contraceptives or hormone replacement therapy
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥3), premature birth with toxemia of pregnancy, or growth restricted infant

Level 2 Risk factors (2 points)

- Age 60-74 years
- Previous malignancy

Level 3 Risk factors (3 points)

- Age 75 years or more
- History of SVT, DVT/PE
- Family history of DVT/PE
- Present factor V leiden
- Positive prothrombin 20210A
- Elevated serum homocysteine
- Positive lupus anticoagulant
- Elevated anticardiolipin antibodies
- Heparin-induced thrombocytopenia (HIT)
- Other thrombophilia _____

Literature Risk Factors

- Peritoneal dialysis
- Sedentary lifestyle
- Low albumin (<3.5 g/dl)
- Low hematocrit (<40% for men and <36% for women)
- CMV infection

Appendix B

Table B1

Project Team and Stakeholder Roster

Position	Project Role
DNP Student	Conduct chart review, collect data
Transplant Center Manager	Content expert, change champion, opinion leader
Transplant APRN	Content expert, change champion
Transplant Patient Care Coordinator	Content expert, change champion
Transplant Pharmacist	Content expert, opinion leader
PI Coordinator	Change champion
Staff	Ancillary support
Transplant Physicians	Consumer of intervention
Administration	Oversees results

Note. DNP = doctor of nursing practice; APRN = advanced practice registered nurse; PI = principal investigator.

Table B2

Stakeholder Contribution Evaluation

Position	Increasing credibility	Assist in design of evaluation plan	Implementing the intervention	Advocate for changes	Fund or authorize action to implement findings
QMCTC Manager	x	x		x	x
Transplant APRN	x	x	x	x	
Transplant Patient Care Coordinator	x	x	x	x	
Transplant Pharmacist	x	x			
Transplant Staff	x		x		
Transplant Physicians	x				
QMC Administrators					x

Note. QMCTC = Queen's Medical Center Transplant Center; APRN = advanced practice registered nurse; QMC = The Queen's Medical Center.

Table B3

Stakeholder Support Evaluation

Position	Program Description	Evaluation Question	Data Collection	Data Management	Data Analysis	Dissem-ination
QMCTC Manager	x	x	x	x		x
Transplant APRN	x	x	x			
Transplant Patient Care Coordinator	x	x	x			
Transplant Pharmacist	x	x				
Transplant Staff			x			
Transplant Physicians	x					
QMC Administrators						

Note. QMCTC = Queen's Medical Center Transplant Center; APRN = advanced practice registered nurse; QMC = The Queen's Medical Center.

Appendix C

Pre-implementation Transplant Physician Survey

1. How much of a problem is thrombosis post-kidney transplant at The Queen's Transplant Center?
1 – Not a problem at all
2 – Minor problem
3 – Moderate problem
4 – Severe problem

2. How much of a priority is it to assess patients for thrombotic risk prior to kidney transplant?
1 – Not a priority
2 – Low priority
3 – Medium priority
4 – High priority
5 – Essential

3. How comfortable are you in assessing patients for thrombotic risk prior to kidney transplant?
1 – Very uncomfortable
2 – Somewhat uncomfortable
3 – Neutral
4 – Somewhat comfortable
5 – Very comfortable

5. Do you currently use a validated, standardized thrombosis risk assessment tool?
1 – No, and not considered
2 – No, but considered
3 – Yes, but I use my own tool or adapted tool
4 – Yes, I use a validated, standardized tool

6. If a standardized thrombosis risk assessment tool were to be used on your patients, how useful would the information be to your practice?
1 – Not at all useful
2 – Slightly useful
3 – Somewhat useful
4 – Very useful
5 – Extremely useful

7. Whose responsibility should it be to complete the standardized thrombosis risk assessment tool?
1 – Physician/surgeon
2 – Nursing staff
3 – Patients should fill it out themselves

8. How likely are you to continue using the standardized thrombosis risk assessment tool?
1 – Extremely unlikely
2 – Unlikely
3 – Neutral
4 – Likely
5 – Extremely likely

Appendix D

Post-implementation Transplant Physician Survey

1. How useful was the information from the thrombosis risk assessment tool?
1 – Not at all useful
2 – Slightly useful
3 – Somewhat useful
4 – Very useful
5 – Extremely useful

2. The information from this thrombosis risk assessment tool influenced my prophylaxis decisions.
1 – Strongly disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly agree

3. Should this thrombosis risk assessment be continued?
1 – Strongly oppose
2 – Somewhat oppose
3 – Neutral
4 – Somewhat favor
5 – Strongly favor

4. How could this thrombosis risk assessment tool be improved?

5. Other comments and feedback.

Appendix E

Table E1

Summary of RTR Patient Demographics

Patient Number	Age (years)	Sex	Ethnicity
2	28	M	Filipino
4	50	M	Filipino
5	68	M	Japanese
8	61	F	Chinese
12	65	M	Filipino
13	63	M	Japanese
14	49	M	Japanese
15	53	M	Filipino
16	49	M	Hawaiian, Filipino, Japanese
18	36	M	Filipino
21	29	M	Samoan, Portuguese, Japanese
22	37	M	Caucasian

Note. The data for the patients who did not undergo transplant surgery has been omitted. RTR = renal transplant recipient.

Table E2

Summary of RTR QMCTC-modified Caprini Tool Level 1 Risk Factors

Patient Number	Age (years)	Age 40-59 (years)	History of Prior Major Surgery	Varicose Veins	History of IBD	Swollen Legs (Current)	Obesity (BMI >30)	COPD	Leg Plaster Cast or Brace	Blood Transfusion (<1 month)
2	28									
4	50	50								
5	68		Cardiac stent							
8	61									
12	65									
13	63									
14	49	49	Liver and kidney transplant							
15	53	53	Kidney transplant							
16	49	49								
18	36									
21	29					RLE swelling from recent AVG revision				
22	37					(BLE amputation)				

Note. The Level 1 Risk Factors for Women for Patient 8 were negative and have been omitted. For clarity, blank results indicate a negative value. RTR = renal transplant recipient; QMCTC = Queen's Medical Center Transplant Center; IBD = inflammatory bowel disease; BMI = body mass index; COPD = chronic obstructive pulmonary disease; RLE = right lower extremity, AVG = arteriovenous graft; BLE = bilateral lower extremity

Table E3

Summary of RTR QMCTC-modified Caprini Tool Level 2 Risk Factors

Patient Number	Age (years)	Age 60-74 (years)	History of Cancer
2	28		
4	50		
5	68	68	
8	61	61	
12	65	65	
13	63	63	
14	49		
15	53		
16	49		
18	36		
21	29		
22	37		

Note. For clarity, blank results indicate a negative value. RTR = renal transplant recipient; QMCTC = Queen's Medical Center Transplant Center.

Table E4

Summary of RTR QMCTC-modified Caprini Tool Level 3 Risk Factors

Patient Number	Age (years)	Age 75+ (years)	History of SVT, DVT, or PE	Family History of DVT or PE	Factor V Leiden	Prothrombin 20210A
2	28				Not tested	Not tested
4	50			(Unknown - patient was adopted)	Not tested	Not tested
5	68				Not tested	Not tested
8	61				Not tested	Not tested
12	65				Not tested	Not tested
13	63				Not tested	Not tested
14	49				Not tested	Not tested
15	53				Not tested	Not tested
16	49				Not tested	Not tested
18	36				Not tested	Not tested
21	29				Not tested	Not tested
22	37				Not tested	Not tested

Note. For clarity, blank results indicate a negative value. RTR = renal transplant recipient; QMCTC = Queen's Medical Center Transplant Center; SVT = superficial venous thrombosis; DVT = deep vein thrombosis; PE = pulmonary embolism.

Table E5

Summary of RTR QMCTC-modified Caprini Tool Level 3 Risk Factors

Patient Number	Elevated Serum Homocysteine	Lupus Anticoagulant	Elevated Anticardiolipin Antibodies	Heparin-induced Thrombocytopenia	Other Thrombophilia
2	Not tested	Not tested	Not tested	Not tested	
4	Not tested	Not tested	Not tested	Not tested	
5	Not tested	Not tested	Not tested	Not tested	
8	Not tested	Not tested	Not tested	Not tested	
12	Not tested	Not tested	Not tested	Not tested	
13	Not tested	Not tested	Not tested	Not tested	
14	Not tested	Not tested	Not tested	Not tested	
15	Not tested	Not tested	Not tested	Not tested	
16	Not tested	Not tested	Not tested	Not tested	
18	Not tested	Not tested	Not tested	Not tested	
21	Not tested	Not tested	Not tested	Not tested	
22	Not tested	Not tested	Not tested	Not tested	

Note. For clarity, blank results indicate a negative value. RTR = renal transplant recipient; QMCTC = Queen's Medical Center Transplant Center.

Table E6

Summary of RTR QMCTC-modified Caprini Tool Literature Risk Factors

Patient Number	Peritoneal Dialysis (PD)	Sedentary Lifestyle	Low Albumin (<3.5 g/dL)	Low Hematocrit (<40% M, <36% F)	CMV Infection
2		Denies		32.6%	
4		Denies		37.5%	
5		Denies		33.2%	
8		Denies			
12		Denies		31.1%	
13	On PD	Denies		28.8%	Not tested
14		Denies		33.9%	
15		Denies		38.1%	
16		Denies		34.2%	
18		Denies		34.5%	
21		Denies		29.7%	
22		Denies		39%	Not tested

Note. For clarity, blank results indicate a negative value. RTR = renal transplant recipient; QMCTC = Queen's Medical Center Transplant Center; CMV = cytomegalovirus.

Appendix F

Table F1

Summary of AACN Essentials and this DNP Project

Essential	Selected Description	Project Demonstration
I: Scientific Underpinnings for Practice	Integrate nursing science with knowledge from ethics, the biophysical, psychosocial, analytical, and organizational sciences as the basis for the highest level of nursing practice.	The EBP nature of this project involved the integration of concepts from the sciences and translating them into a practice change.
II: Organizational & Systems Leadership for Quality Improvement and Economics	Develop and evaluate care delivery approaches that meet current and future needs of patient populations based on scientific findings in nursing and other clinical sciences, as well as organizational, political and economic sciences.	This EBP project demonstrated the design, implementation, and evaluation of a project based on the needs of the renal transplant population.
III: Evidence-Based Practice & Translation Science	Use analytic methods to critically appraise existing literature and other evidence to determine and implement the best evidence for practice.	Chapter 2 describes the critical search and appraisal of the literature and the translation of those findings into the development of a practice change.
IV: Information Systems & Technology	Design, select, use, and evaluate programs that evaluate and monitor outcomes of care, care systems, and quality improvement including consumer use of health care information systems.	Chapter 3 describes the development of an evaluation program to monitor the outcomes for this project.

Note. Adapted from AACN (2006). AACN = American Association of Colleges of Nursing; DNP = Doctor of Nursing Practice; EBP = evidence-based practice.

Table F2

Summary of AACN Essentials and this DNP Project

Essential	Selected Description	Project Demonstration
V: Health Care Policy & Ethics	Demonstrate leadership in the development and implementation of institutional, local, state, federal, and/or international health policy.	A quality improvement program was developed through this project. The outcomes of the project informed the possible need for an institutional change in health policy.
VI: Inter-professional Collaboration	Lead interprofessional teams in the analysis of complex practice and organizational issues.	Chapter 2 describes the formation of team of interdisciplinary team members tasked with the design, implementation, and evaluation of this project.
VII: Prevention and Population Health	Synthesize concepts, including psychosocial dimensions and cultural diversity, related to clinical prevention and population health in developing, implementing, and evaluating interventions to address health promotion/disease prevention efforts, improve health status/access patterns, and/or address gaps in care of individuals, aggregates, or populations.	One of the goals of this project was to prevent and reduce the incidence of VTEs (clinical prevention). This project was a program to address this clinical issue.
VIII: Advanced Nursing Practice & Education	Design, implement, and evaluate therapeutic interventions based on nursing science and other sciences.	This EBP project encapsulated the design, implementation, and evaluation of an intervention, as directed by the literature.

Note. Adapted from AACN (2006). AACN = American Association of Colleges of Nursing; DNP = Doctor of Nursing Practice; EBP = evidence-based practice; VTE = venous thromboembolism.